Distress calls of Black-headed Nightingale-Thrush *Catharus mexicanus* and Chestnut-capped Brushfinch *Arremon brunneinucha*

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Las llamadas de angustia son vocalizaciones fuertes y altamente localizables, típicamente exhibidas por las aves cuando son atrapadas por un depredador. La función de estas llamadas está determinada en gran parte por sus propiedades acústicas. Por lo tanto, las descripciones de las llamadas de angustia representan un paso fundamental hacia la comprensión de la función y la relevancia evolutiva de estas señales. En esta nota proporcionamos la primera descripción de las llamadas de angustia de dos aves neotropicales: Zorzal Cabecinegro *Catharus mexicanus* y Saltón Cabecicastaño *Arremon brunneinucha*. Alentamos a los investigadores a proporcionar estas descripciones en otras especies de aves para aumentar el conocimiento de la naturaleza de estas señales en diferentes linajes.

Distress calls are highly specialised signals emitted by birds when captured by a predator or handled by a human[15]. They are typically loud signals exhibiting a harmonic and sometimes harsh structure slowly modulated in frequency[1]. The structure of distress calls is thought to be similar across species, showing an apparent structural convergence[12,13], presumably as a result of similar selective pressures acting on them. Several hypotheses have been advanced to explain their function, including startling a predator into releasing the bird[7], attracting a secondary predator[9,10], and calling for help[19]. While avian distress calls tend to be acoustically similar among species, this relative similarity does not necessarily mean that they serve the same function. Indeed, their function is expected to vary in relation to different factors, such as species ecology and social organisation[12]. Furthermore, despite the relative uniformity of these signals, calls of different species may vary in length, frequency modulation, bandwidth, harmonic structure and harshness[2]. Because the function of these signals is—at least partly—determined by their acoustic characteristics[12], descriptions of distress calls represent a fundamental step towards understanding both their ecological functions and evolutionary relevance. Because capture by a predator is simulated during mist-netting (when a bird is handled) and birds readily produce distress calls during such interactions, these settings provide good opportunities to document distress calls.

Here, we provide the first descriptions of the distress calls of two Neotropical birds: Black-headed Nightingale-Thrush *Catharus mexicanus* and Chestnut-capped Brushfinch *Arremon brunneinucha*. We then discuss opportunities for ornithologists to collect and archive similar data, as a thorough acoustic dataset is a fundamental step towards understanding the evolution of acoustic signals.

Methods

From June to August 2019, we opportunistically obtained recordings from vocalising birds while conducting mist-netting sessions operated during 06h00–12h00 in Cusuco National Park, San Pedro Sula, Honduras (15°31'10.6248"N 88°14'27.9708"W; 2,000 m elevation). Such vocalisations in the hand are unlike acoustic observations of the species in the field because comparable events of acute distress (e.g., predator capture) are rarely witnessed. As such, when vocalisations differed from the species' vocalisations in the field and were given in response to close human contact, we determined them as distress calls. Whenever a mist-net check was performed, a recordist (DZ) used the built-in microphone of a Marantz PMD661MKII to record distress calls of birds vocalising in the mist-net and / or when the bird was handled by a researcher to take mensural data. All distress calls were recorded as uncompressed, 16-bit WAV files with a sample rate of 48 kHz.

Recordings were analysed using the software Raven Pro 1.6[5]. Qualitative descriptions of calls were performed by visual inspection of sonograms (150-point FFT length Hann window, 90% overlap, 460 Hz filter bandwidth) following the Pieplow[17] terminology for tone qualities and pitch patterns. Length of calls was measured via cursor placement on the oscillogram, as this representation of sound clearly shows the onset and offset of each vocalisation given the good signal-to-noise ratio of our recordings. Four frequency measurements were considered: lowest, highest and peak frequency, plus bandwidth. All measurements were obtained using a power spectrum (512-point FFT length Hann window, 90% overlap, 135 Hz filter bandwidth) to avoid dramatic biases in frequency measurements obtained with cursor placement in sonograms[21].

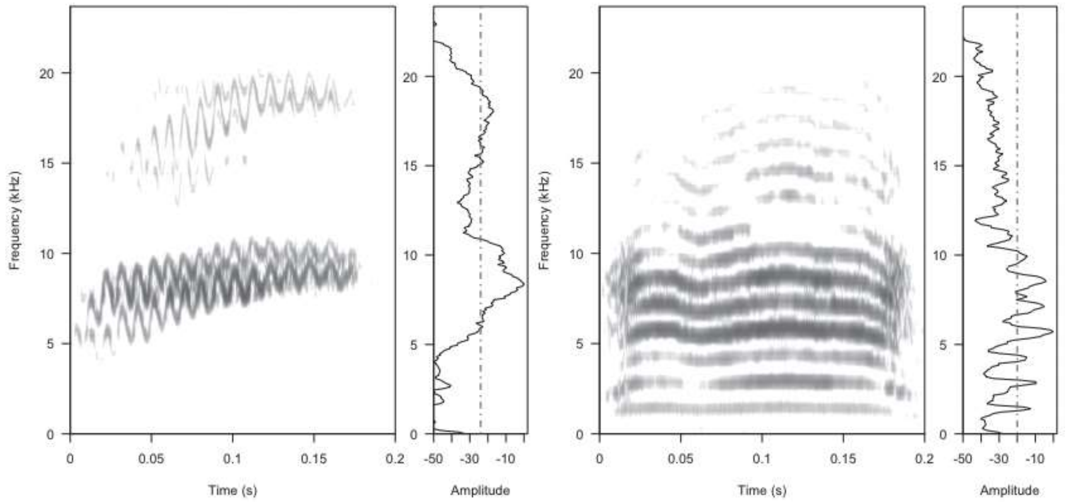

Figure 1. Close-up sonogram view of the distress calls elicited by Chestnut-capped Brushfinch *Atlapetes brunneinucha* (left) and Black-headed Nightingale-Thrush *Catharus mexicanus* (right) recorded in broadleaf forest at Cusuco National Park, San Pedro Sula, Honduras, June 2019. Power spectrums next to sonograms represent the distribution of energy in the frequency domain. Red dotted lines mark the -24 and -20 dB threshold, respectively. Note the highly modulated frequency call in *A. brunneinucha* in contrast to the hardly modulated and highly harmonic call of the *C. mexicanus*. Graphs obtained using *seewave* R package[20].

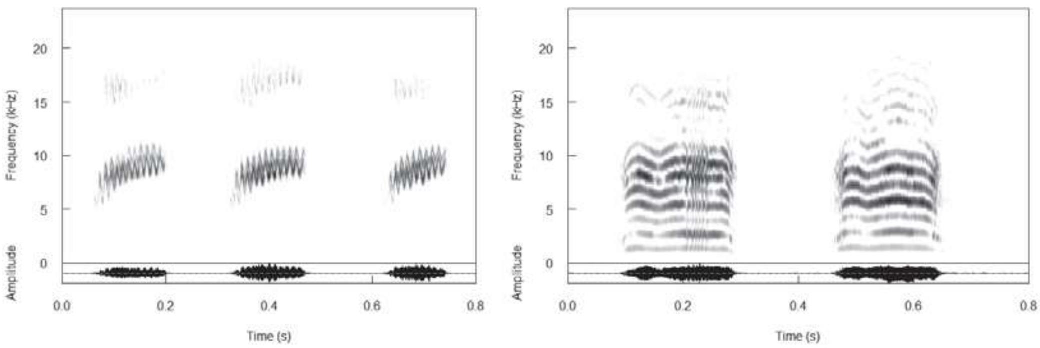

Figure 2. Sonogram view of a sequence of distress calls elicited by Chestnut-capped Brushfinch *Atlapetes brunneinucha* (left) and Black-headed Nightingale-Thrush *Catharus mexicanus* (right) recorded in broadleaf forest at Cusuco National Park, San Pedro Sula, Honduras, June 2019. Oscillograms below show the distribution of energy in the time domain. Note the shorter length of *A. brunneinucha* calls, which permits more vocalisations to be rendered in the same time lapse compared to *C. mexicanus*. Graphs obtained using *seewave* R package[20].

We set a mark from the max. amplitude frequency to identify lowest and highest frequencies for both species: -24 dB for *A. brunneinucha* and -20 dB for *C. mexicanus* (Fig. 1). These amplitude thresholds were chosen *a priori* based on the recording quality so that they would encompass most of the sound energy above the background noise. These thresholds permitted standardised measurements among recordings for each species. We obtained recordings from five *A. brunneinucha* and two *C. mexicanus* (Table 1), and for each individual five calls were measured (total calls analysed: 25 for *A. brunneinucha* and ten for *C. mexicanus*). For *A. brunneinucha* measurements were performed only on fundamental frequency (Fig. 1).

Results

Black-headed Nightingale-Thrush *Catharus mexicanus*

Distress calls were characterised by a broadband marked harmonic structure (>15 harmonics) with an overslurred pitch pattern exhibiting very little frequency modulation and a variable noisy quality